



PRINCIPLES

- Objective
- Simplicity
- Unity of command
- Offensive
- Concentration of superior force
- Surprise
- Security

*From: Alberts, David S. and Hayes, Richard E., **Command Arrangements for Peace Operations**, National University Press Publications, Washington, DC, May 1995.*



PARADIGM

- Mission
- Enemy
- Terrain
- Troops
- Time available



PROBLEM

Human Behavior



OUTLINE

- Background
- Command and control
- Human behavior



BACKGROUND

- MACRO:
 - A changing world
 - Roads to war
 - The role of information
- MICRO
 - Emergence of data
 - Rediscovery of behavior and performance
 - Requirements for training



MACRO ISSUES

- Different scenarios
- Importance of warning
- Force generation:
 - Mobilization
 - Deployment
 - Support and sustainment

We must pay more attention to the forces involved, how we put them in Theater and how we provide them support -- the general's job

— Continued —



MACRO ISSUES

(Concluded)

- Information dominance or superiority is now a critical issue:
 - Technically it may be more dynamic
 - Tactically it can be key
 - Operationally it can be decisive
- Trend evident for ten years:
 - Precision munitions
 - Target acquisition
 - Deep fires
 - Intelligence and surveillance

We must understand the dynamics and outcomes of the information war



BACKGROUND

- Evolution of Constructive Combat Models:
 - Data based factors and tables
 - Physics of combat
 - Statistical fit
 - Object oriented — distributed and interactive
- Representations of Command and Control:
 - Scripted
 - Interactive
 - Rule based
- Human Behavior and Human Performance:
 - Marshall factor
 - Determinants
 - Shared conceptual models



THE TOOLS OF THE OPERATIONAL ART

- Well trained — well led — tactical forces
- Effective cross-service (USAF/Army) support
- An officer corps with an historical perspective on the operational art
- **Mastery** of the functional, organizational, and procedural dimensions of the **Command and Control** of an airland force



THE FUNCTIONAL ELEMENTS OF THE FORCE

- Combat — maneuver
- Combat support
- Combat service support
- Cross-service support
- Allied counterparts



THE VERTICAL FUNCTIONAL SYSTEMS

(INPUT-PROCESS-OUTPUT)

Control:

- Maneuver control system
- Fire support — artillery tactical and technical fire control
- Air defense — SHORAD C²
- Engineer — mobility/countermobility C²
- Tactical air control system
- Intelligence control system
- EW control system
- CSS control systems — maintenance, supply, transportation, medical, administration



THE VERTICAL FUNCTIONAL SYSTEMS

(INPUT-PROCESS-OUTPUT)

(Continued)

Scope/Span:

- | | |
|--------------------------|--------------------|
| • Maneuver control | Joint to company |
| • Fire control | Joint to battery |
| • Air defense | Joint of Stinger |
| • Engineer | Corps to company |
| • TACS | Joint to TACP |
| • INTEL system | CONUS to collector |
| • EW | Joint to jammer |
| • Combat Service support | CONUS to company |

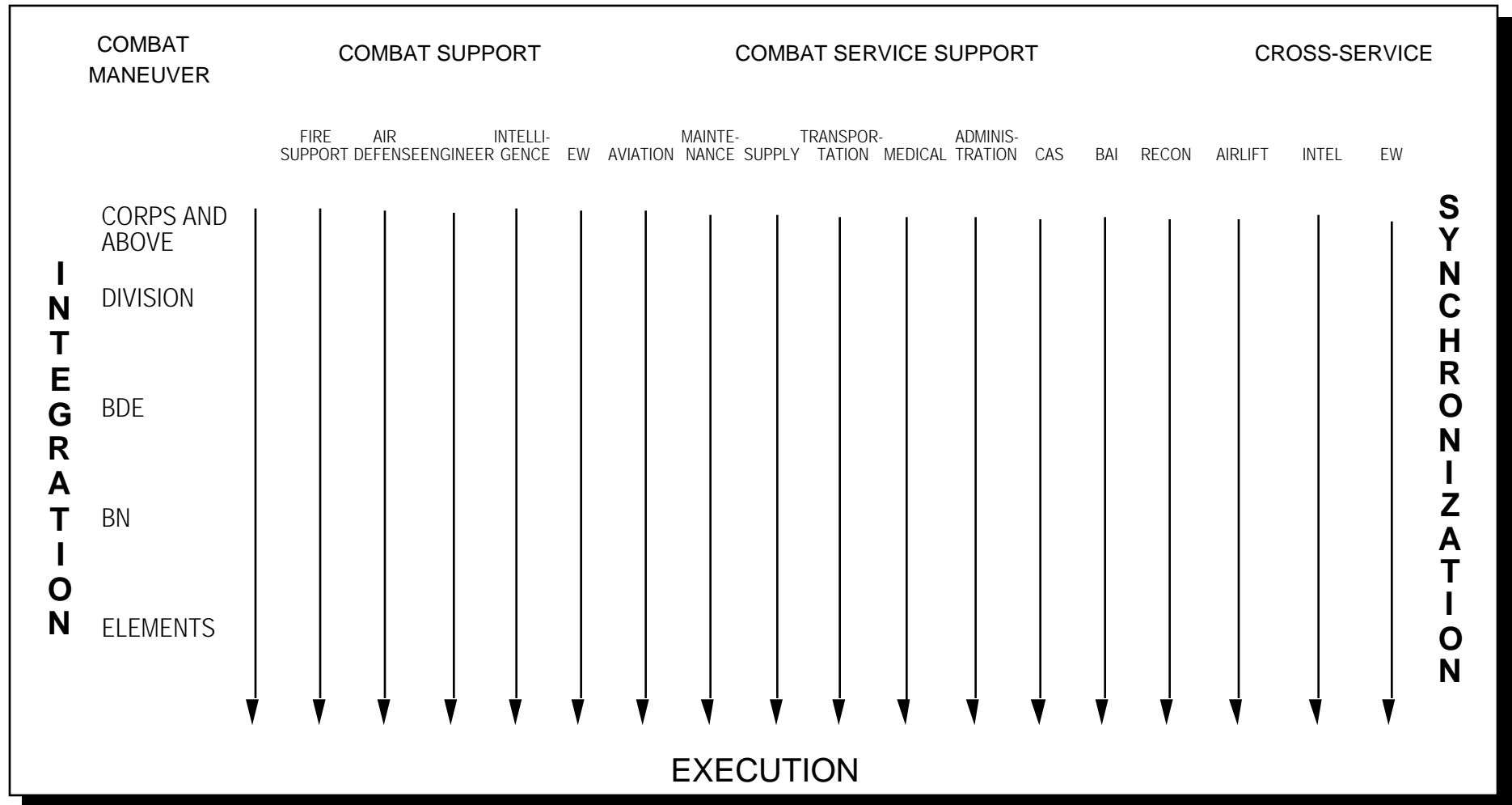
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THE VERTICAL FUNCTIONAL SYSTEMS

(INPUT-PROCESS-OUTPUT)

(Concluded)





ECHELONMNET FOR C² HORIZONTAL INTEGRATION

- Force control:
 - Company-troop-squadron-battalions of the maneuver force
 - Brigades and divisions
 - Corps
 - Joint EAC
 - Combined EAC



C² PROCESSES

UNDERSTANDING THE IDEAS WHICH LIE AT THE HEART OF THE C² PROCESS

- Developing nested concepts of operation: the critical path
- Specifying task organization
- Specifying/clarifying command relationships
- Establishing cross-service procedures and organization

— Continued —



C² PROCESSES

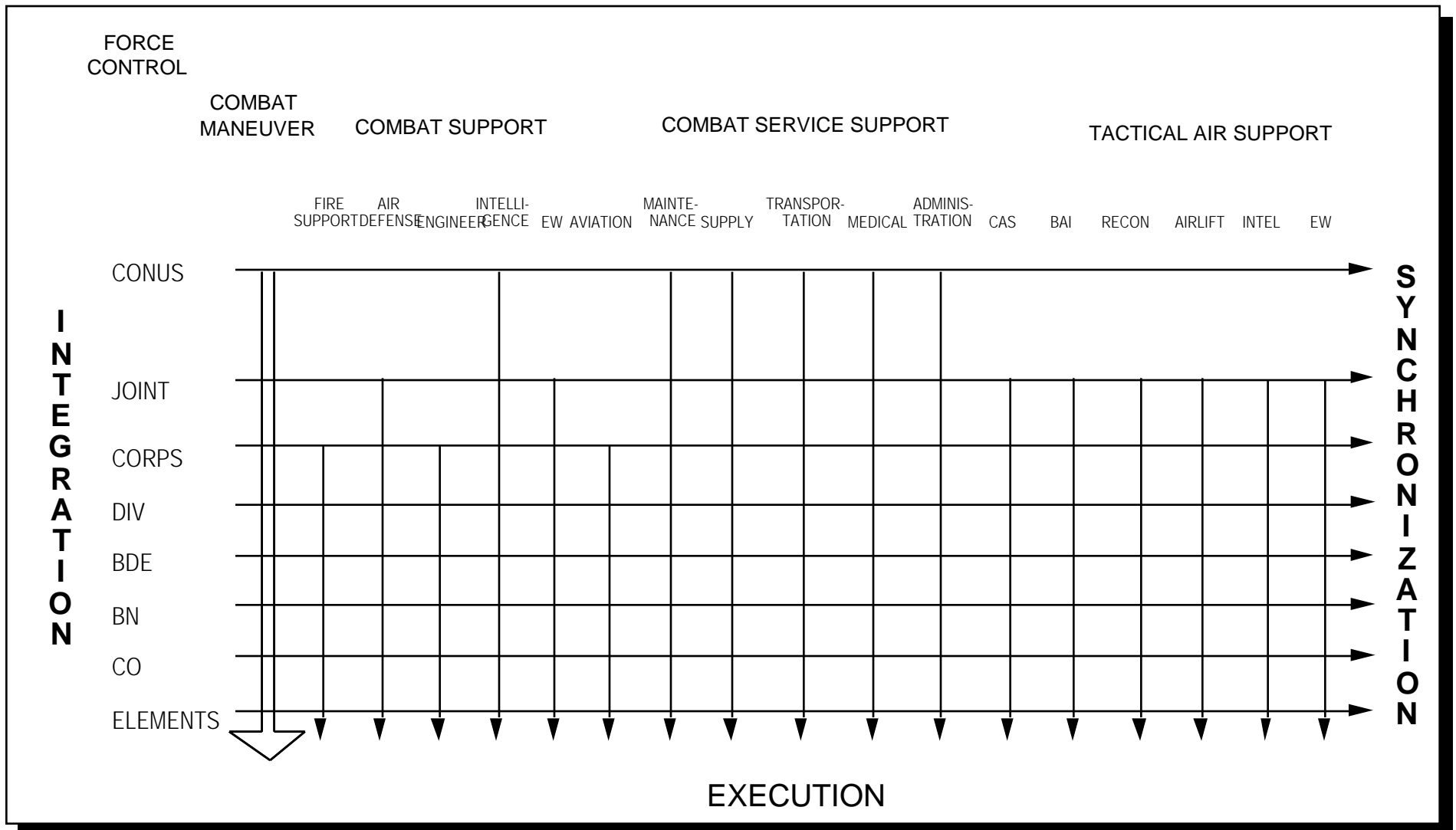
(Concluded)

- Directing tactical synchronization of combat support, combat service support, and cross-services functions with maneuver
- Conducting corps collateral operations
- Harmonizing major campaigns
- Conducting joint collateral operations



TACTICAL SYNCHRONIZATION

THE C² MATRIX





C² PROCESSES

CONCEPTS OF OPERATION

- Concepts of operation — critical paths — are:
 - Required at every functional, tactical, and operational echelon at all times
 - The principal input of the commander himself
 - The precise definition of the commander's "intent"
 - The vehicle for applying:
 - Tactical skills
 - Operational art
 - Articulation of airland battle doctrine
 - The principle of war
 - Built around a scheme of maneuver

— Continued —



C² PROCESSES

CONCEPTS OF OPERATION (Continued)

- Concepts of operation provide:
 - The basis for AUFTRAG
 - The basis for task organization
 - The basis for synchronization
 - The missions for collateral campaigns
 - The missions for major campaigns
 - The missions for joint collateral operations

— Continued —



C² PROCESSES

CONCEPTS OF OPERATION (Concluded)

- Concepts of operations are nested in order to:
 - Extend the top commander's intentions throughout the force
 - Adapt more precisely at each echelon to local METT
 - Trace the critical path of the main effort — the Schwerpunkt
- Concepts of operation are the distillation of the commander's:
 - Training — education
 - Experience
 - Character and such genius as he may possess



C² PROCESSES

TASK ORGANIZATION

- The force is tailored to:
 - Support the concept
 - Weight the main effort — distribute the support along the critical path
 - Provide combined arms capabilities at every tactical echelon
 - Adept to METT at every level
 - Preserve the organizational integrity and continuous control of the vertical functions



C² PROCESSES

COMMAND RELATIONSHIPS

- Include:
 - The C² rules which preside over the task organization
 - The decision to attach functional elements or place them in direct or general support
 - Cross-service support mechanisms
- Attachment is favored:
 - For all maneuver forces
 - For independent forces operating in a separate terrain compartment outside supporting range

— Continued —



C² PROCESSES

COMMAND RELATIONSHIPS

(Concluded)

- Direct support or general support is favored:
 - For closely integrated forces
 - When the capability to concentrate support is regarded as more important to battle outcome than independent operations
 - When the commander wishes to preserve the vertical integrity of the functional systems to assure maximum effectiveness



C² PROCESSES

CROSS-SERVICE PROCEDURES

- The basic relationship is support through **cooperation** and **coordination**
- A joint commander may direct, allocate, and apportion tactical air support, but:
 - From corps down the process is coordinative and cooperative
 - It is support, not command
 - The same logic which drives the artillery to support versus attachment drives the Air Force

— Continued —



C² PROCESSES

CROSS-SERVICE PROCEDURES

(Concluded)

- The air-ground operations system (the tactical air control system):
 - Is a standard organization
 - Is put in place automatically for:
 - CAS
 - BAI
 - Reconnaissance
 - Airlift
 - Is expanding to embrace:
 - Surveillance and target acquisition
 - Intelligence integration
 - EW support
- Army support of Air Force is reciprocal



C² PROCESSES

TACTICAL SYNCHRONIZATION

- The Purpose of Synchronization
 - Continuous integration of support functions with maneuver
 - Concentration of weapon **effects** upon the enemy in space and time
 - Generation of peaks of combat intensity at critical places and times **as defined** by the commander's concept of operation
 - Full exploitation of the potential of the force
 - Achieving superior relative combat power through superior (faster, more comprehensive) C² procedures and performance
 - Synchronization is not a tradeoff with agility. Synchronization supports agility. Fast reacting C² procedures and good staff can have it both ways
 - Tactical synchronization extends to corps when corps retains control of certain weapon systems but brigade and division are the chief practitioners

— Continued —



C² PROCESSES

TACTICAL SYNCHRONIZATION

(Continued)

- Synchronization Processes:
 - Maintenance of the vertical integration of functions is a command responsibility at all levels
 - The starting point for synchronization is the concept of operations — the “intent”
 - The first articulation is the task organization and command relationships
 - The second is the initial tasking in the OPORD (or plan)
 - The maximum and easiest synchronization is associated with deliberate operations (attack, defense) when ample time for precision coordination is available

— Continued —



C² PROCESSES

TACTICAL SYNCHRONIZATION

(Concluded)

- **But** initial tactical synchronization remains effective only until the enemy reacts
- Then the commander and staff switch to dynamic and continuous synchronization. This is the greatest challenge to airland battle C²



C² PROCESSES

CORPS COLLATERAL OPERATIONS

- At corps and joint level, synchronization of individual support functions gives way to groupings of support functions integrated into collateral operations. Also keyed to the commander's concept
- Best analogy — peace for Galilee Phase I
- A collateral operation must have a commander who controls the resources dedicated to it during the time of its execution

— Continued —



C² PROCESSES

CORPS COLLATERAL OPERATIONS

(Continued)

- The most likely current US collateral operations at corps level are:
 - Deception
 - Counter C³
 - Counterfire
 - SEAD
 - Second echelon attack
- At Joint Level Are:
 - Special operations
 - Special logistics
 - Air/TMD

— Continued —



C² PROCESSES

CORPS COLLATERAL OPERATIONS

(Continued)

- Even at corps level all collateral operations involve cross-service support
- Collateral operations at corps may be part of joint collateral operations directed by the senior joint commander
- Corps is principal interface with the joint level. Corps executes the army's contribution to **joint** collateral operations

— Continued —



C² PROCESSES

CORPS COLLATERAL OPERATIONS

(Continued)

- Collateral operations are directed by specific missions in the OPOD and keyed to the concept of operations
- Collateral operations have their own internal concepts of operation nested within the concept of the corps and sometimes the joint commander
- Internally, the processes are tactical in nature and require synchronization

— Continued —



C² PROCESSES

CORPS COLLATERAL OPERATIONS

(Concluded)

- Collateral Operations Could Be Comprised of Functional Components as Below:

		FUNCTIONS																			
		COMBAT MANEUVER					COMBAT SUPPORT					COMBAT SERVICE SUPPORT					TAC AIR				
			FS	AD	ENGR	INTEL	EW	MAINT	SUP	TRANS	MED	ADMIN	CAS	BAI	REC	EW	ALFT				
COUNTER C ³	X	X				X	X						X	X	X	X					
COUNTERFIRE		X				X	X						X	X	X	X					
SEAD	X	X				X	X						X	X	X	X					
SPECIAL LOGISTICS (RECONSTITUTION)					X			X	X	X	X						X				



C² PROCESSES

HARMONIZING MAJOR CAMPAIGNS AT THE JOINT LEVEL

(Continued)

- Classic/historic land, sea, and air campaigns:
 - Airland maneuver campaigns: to control land areas in accordance with strategic and political objectives — destroying enemy airland forces as necessary:
 - Campaign in France, WWI
 - Campaign in Europe, WWII
 - Campaign in Korea
 - Maritime campaigns: to achieve and control maritime access to key theaters of operation — destroying enemy maritime and air forces as necessary:
 - Battle of Atlantic, WWI and II
 - Battles in the Pacific on the way to Japan, WWII

— Continued —



C² PROCESSES

HARMONIZING MAJOR CAMPAIGNS AT THE JOINT LEVEL

(Continued)

- Air campaigns: to defeat enemy air forces, protect friendly forces and operations, and destroy or delay or disrupt enemy airland forces in the depth of their territory
 - Bombardment, interdiction, and offensive counterair — Europe, WWII
- Major campaigns are harmonized to achieve the mission assigned to the top joint commander
- All will be conducted under the direction of a top joint commander

— Continued —



C² PROCESSES

HARMONIZING MAJOR CAMPAIGNS AT THE JOINT LEVEL

(Concluded)

- Each will almost certainly be commanded by a senior officer and staff furnished by the dominant service although cross-service and even joint support may be present
- The Army, Navy/Marine Corps, and Air Force have specialized in providing forces, doctrine training, and special equipment for these land, sea, and air campaigns. Service flavor is unavoidable and desirable. Joint interfaces are increasingly accommodated and joint command accepted



THE ULTIMATE PRODUCT OF C²

- The ultimate product of C² is a high degree of exploitation of the potential inherent in the joint force. It mobilizes or activates every level of combat power present on the battlefield
 - Increments of combat power:
 - Level I: Company and battalion fire and maneuver
 - Level II: Combat support and combat service support
 - Level III: Cross-service support CAS, BAI, EW, airlift
 - Level IV: Brigade and division synchronization with maneuver of combat support, combat service support, and cross-service support
 - Level V: Corps conducted collateral operations in support of maneuver
 - Level VI: Joint command level conducts major campaigns supported by joint collateral operations
 - Level VII: Combined force (headquarters) harmonizes national campaigns with cross-reinforcement as permitted by interoperability constraints

— Continued —



THE ULTIMATE PRODUCT OF C^2

(Concluded)

- Degrees of exploitation, effectiveness, and intensity:
 - To the extent that the Blue Force can seize and hold the initiative, the more increments of power it can generate and apply to the enemy
 - To the extent that Red seizes the initiative, the Blue Force will be forced down toward Level I and a sharply lower degree of exploitation and effectiveness



PRINCIPAL SUBJECT MATTER

- The pace of battle
- The fog of war
- The means to control the pace and to command in spite of the fog
- To begin learning before you face an FTX or a battle in the loneliness of command



COMMAND AND CONTROL

- The largest source of variation in multiple realizations of a combat or campaign process is command and control

Paraphrasing Dr. Wilbur Payne --

"In direct fire combat once the forces are laid out and initial conditions established, the outcome is predictable"

- The higher the echelon at which errors are made, the more profound the consequences
- Performance is not uniform. It is a function of many variables, but even when most are controlled, significant differences occur



IMPERFECTIONS IN COMMAND, CONTROL, AND IMPLEMENTATION

- Decisions are neither made nor implemented as designed or desired
- Forces get lost
- Forces don't engage
- Decision makers are not predictable

— Continued —



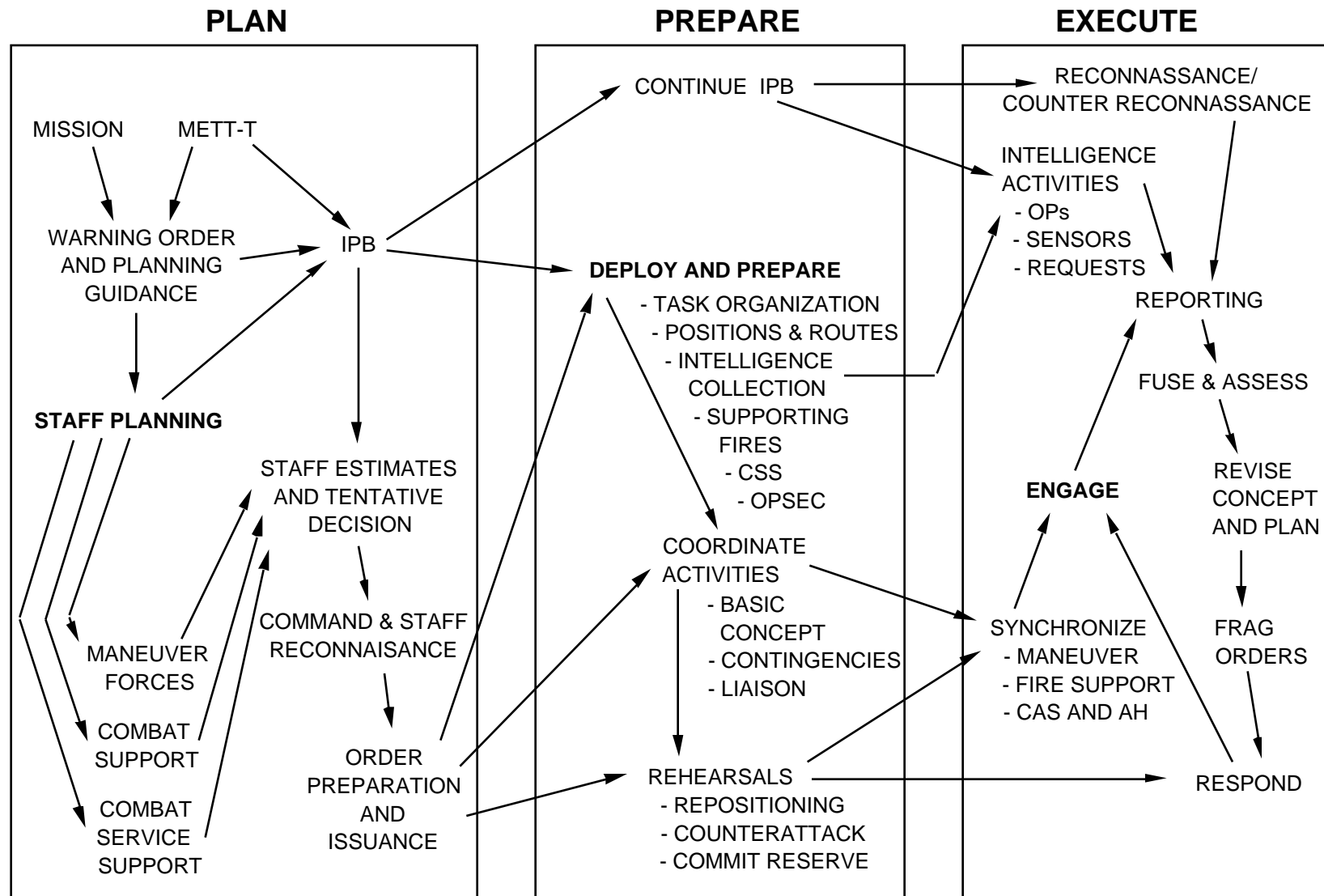
IMPERFECTIONS IN COMMAND, CONTROL, AND IMPLEMENTATION

(Concluded)

- But failures are often not as drastic as many models would suggest
- Command, control, and implementation problems are two-sided
- Backup modes of communication exist
- Field expedients are invented
- Feedback processes limit errors



A CONCEPTUAL MODEL OF TACTICAL C² TASK RELATIONSHIPS





ALL PHASES MUST BE EXAMINED

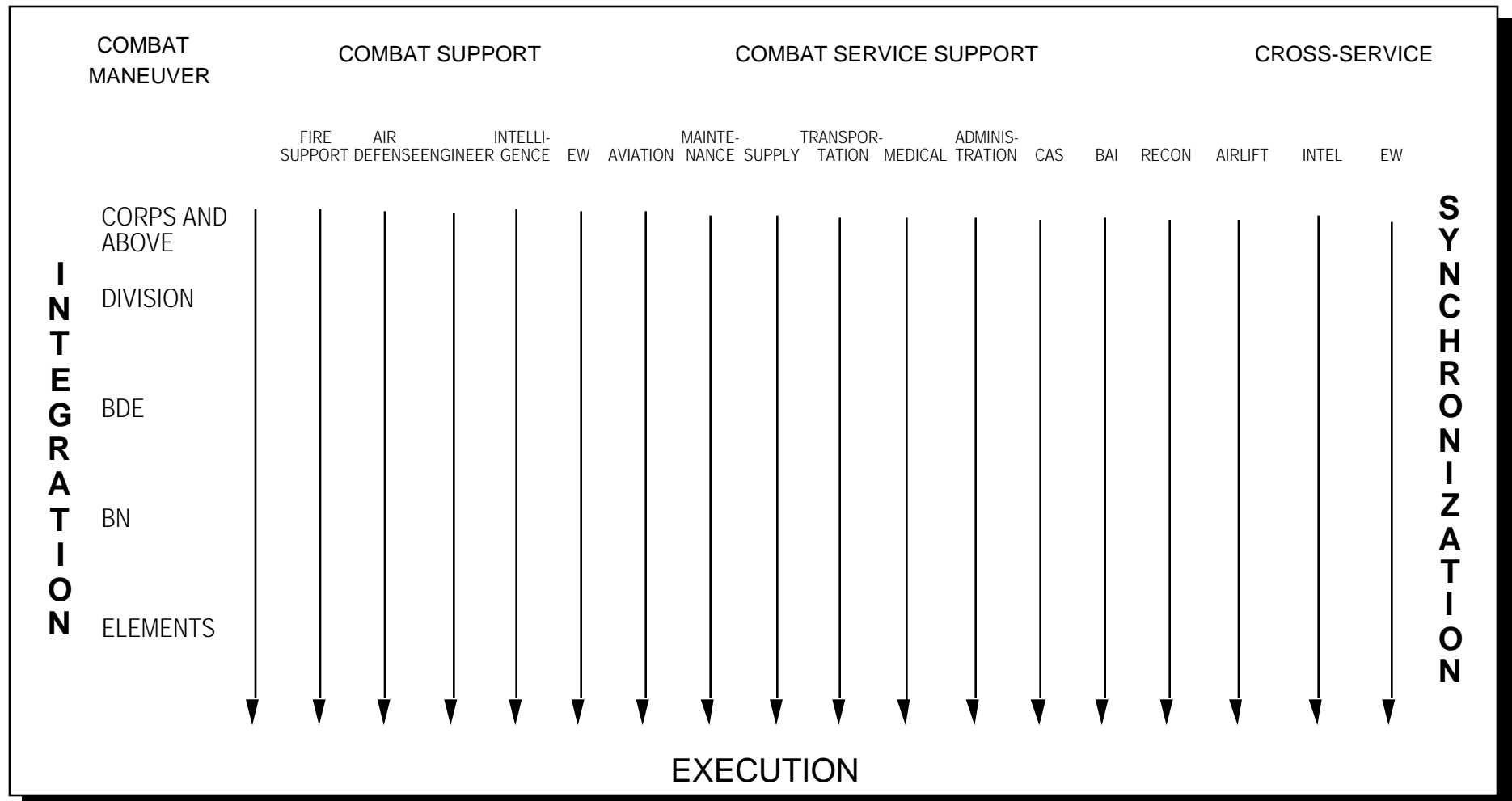
- Planning
- Preparation
- Execution

Must consider the fog of war



TACTICAL SYNCHRONIZATION

THE C² MATRIX





HYPOTHESES ABOUT COMBAT

HYPOTHESIS ONE:

A small unit's performance in delivering "its increment" of combat power is dominated by initial conditions which determine opportunities to participate

HYPOTHESIS TWO:

Determination of initial conditions is dominated by leadership and supervision

— Continued —



HYPOTHESES ABOUT COMBAT

(Concluded)

HYPOTHESIS THREE:

Given opportunities to participate, the level of participation does not vary significantly

HYPOTHESIS FOUR:

Given a decision to participate, soldier/system contribution does not vary significantly

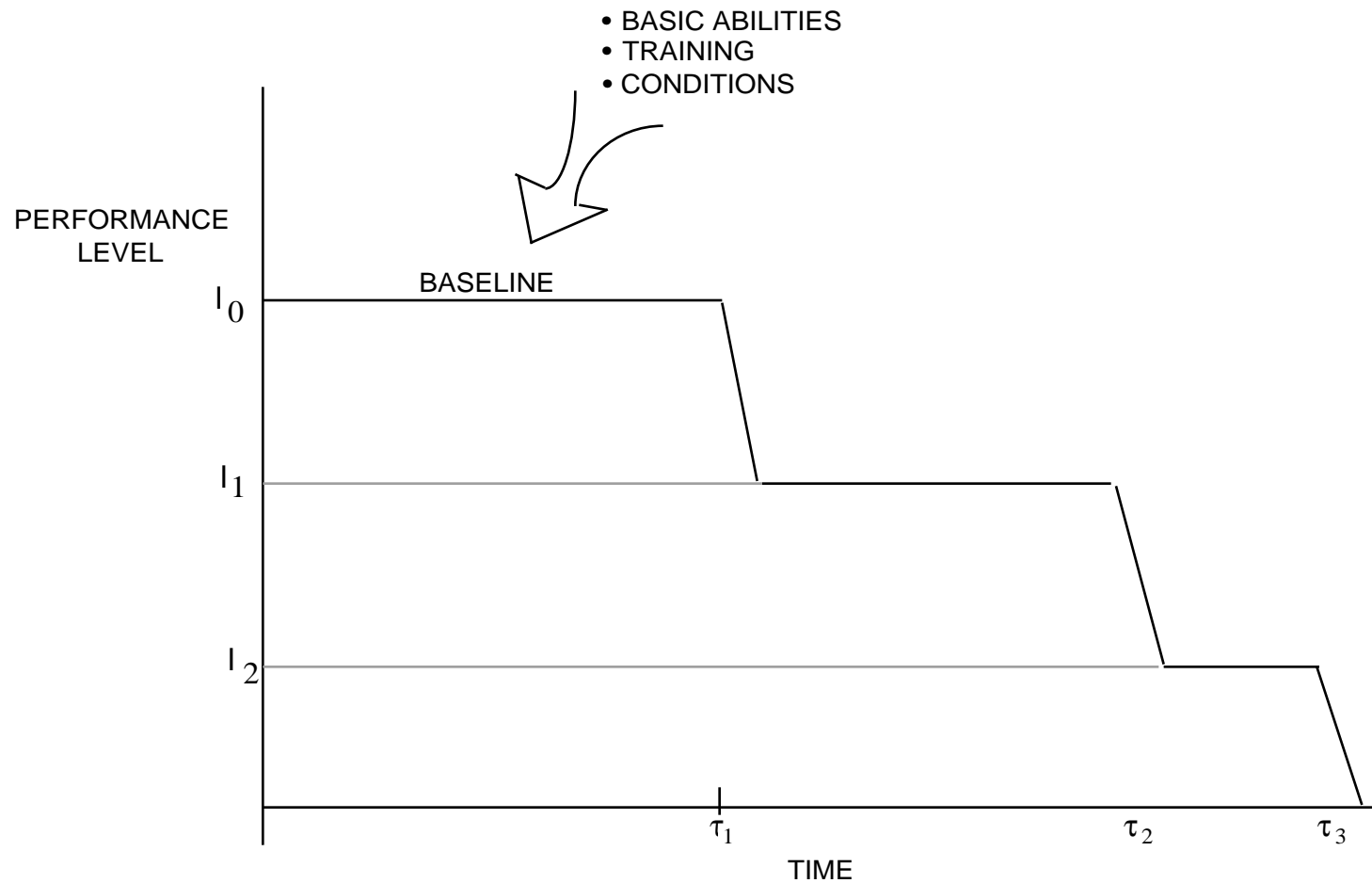


WHAT BEHAVIORS?

- Initiation of appropriate tasks or activity
- Initiation of inappropriate activity
- Failure/reluctance to initiate



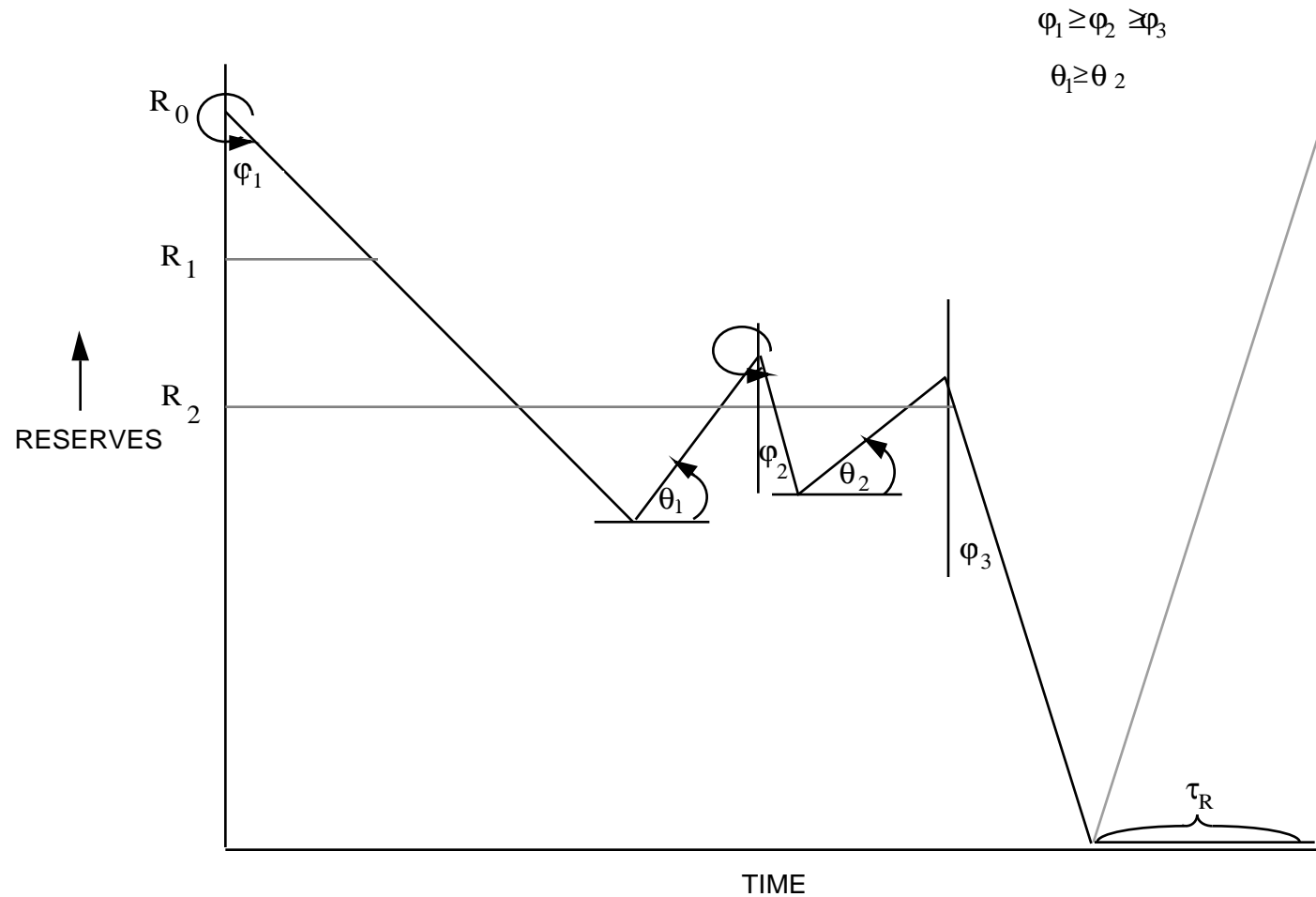
DETERIORATION OF PERFORMANCE



DETERIORATION OF PERFORMANCE

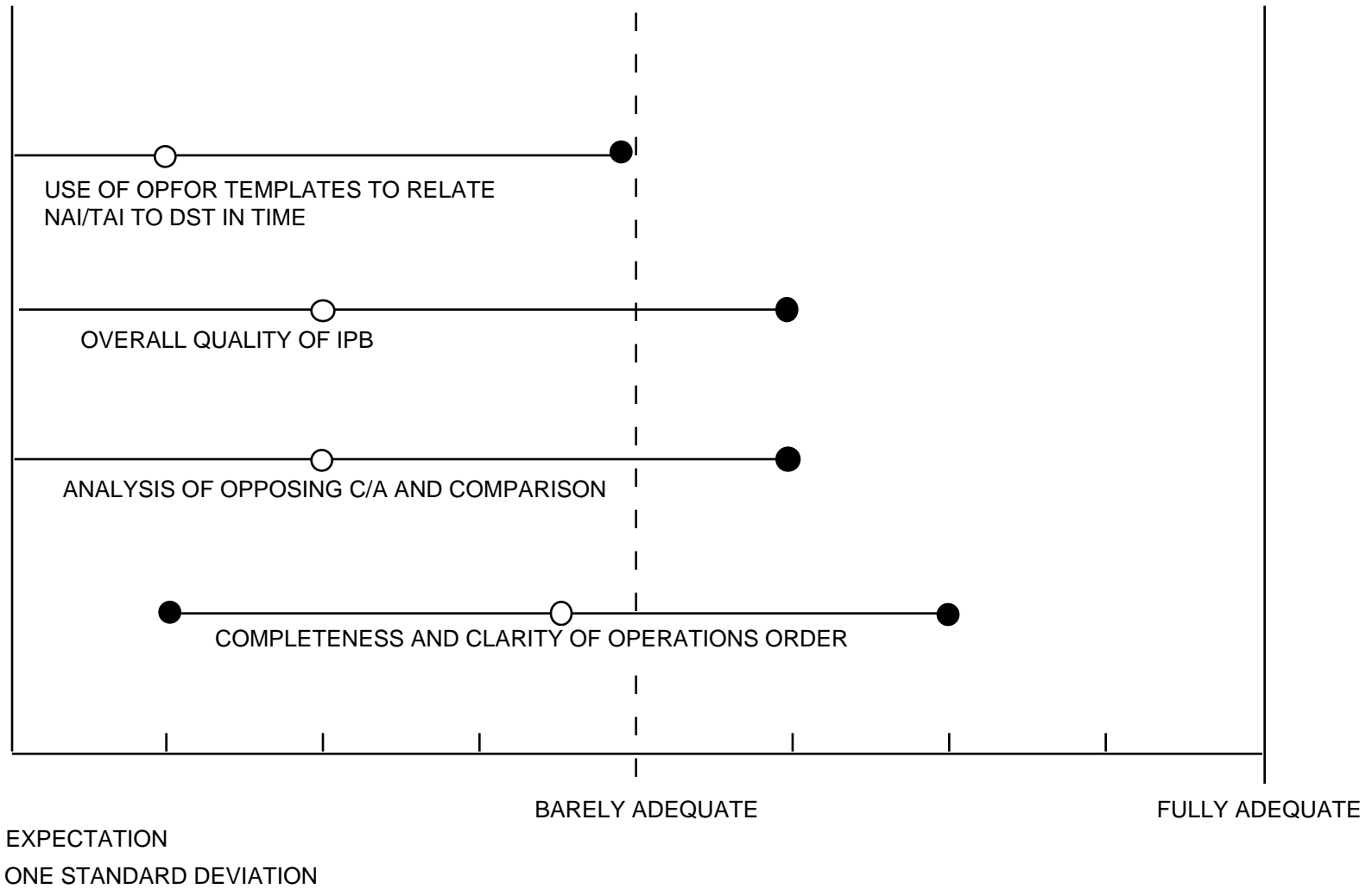


STRESS/RECOVERY PROCESS



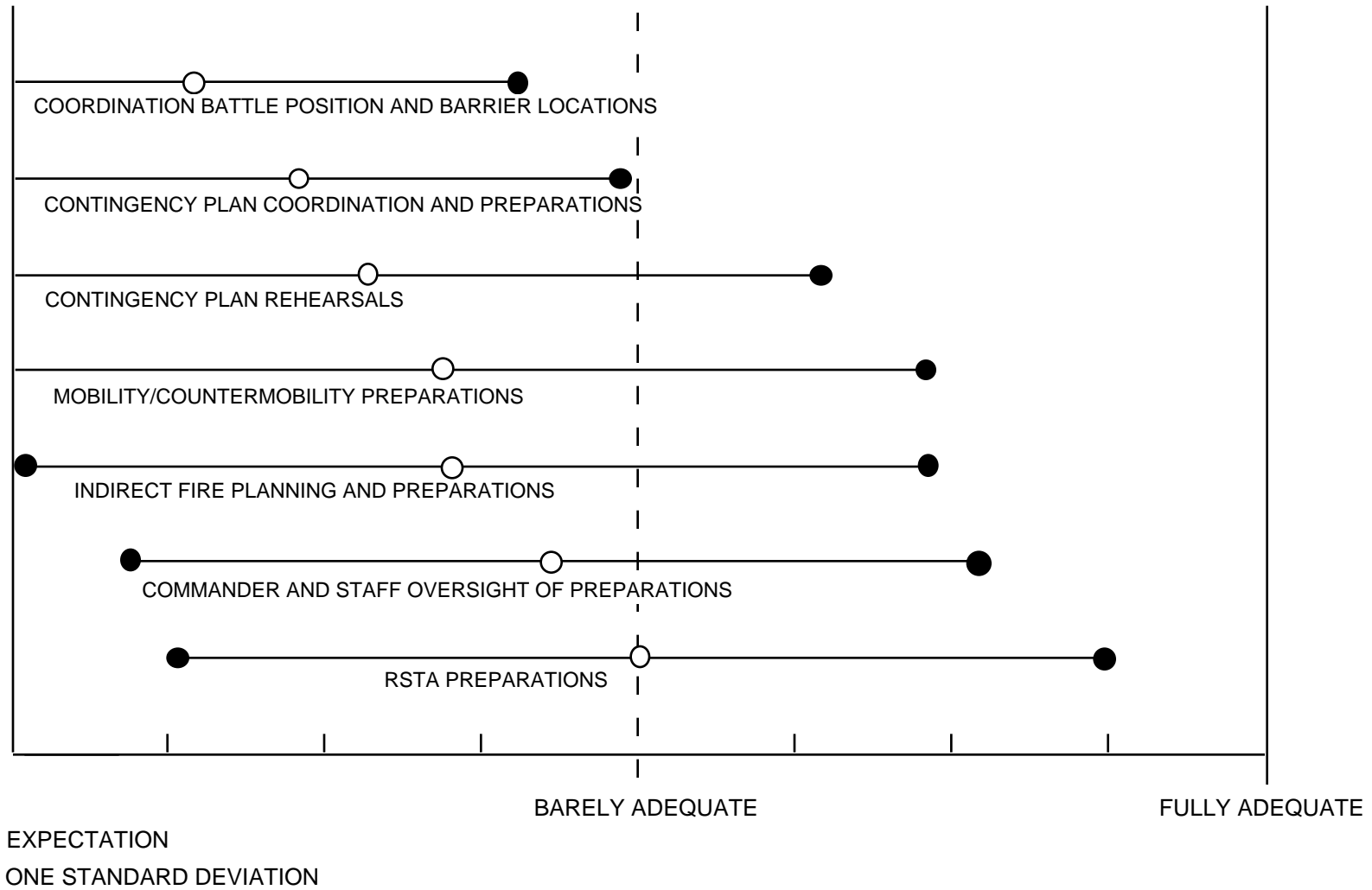


PRINCIPAL FUNCTIONAL SHORTFALLS, BATTALION LEVEL PLANNING





PRINCIPAL FUNCTIONAL SHORTFALLS, BATTALION LEVEL PREPARATION





PARADIGM

- The key factor is not how well a weapon is operated, it is the conditions under which the weapon is brought to bear
- Focus should change:
 - Concept of operations
 - Planning and preparation
 - Execution
- Attributes desired:
 - Sound
 - Synchronized
 - Smooth
- Processes to study:
 - Pace of battle
 - Fog of war



COMBAT MODELS AND SIMULATIONS

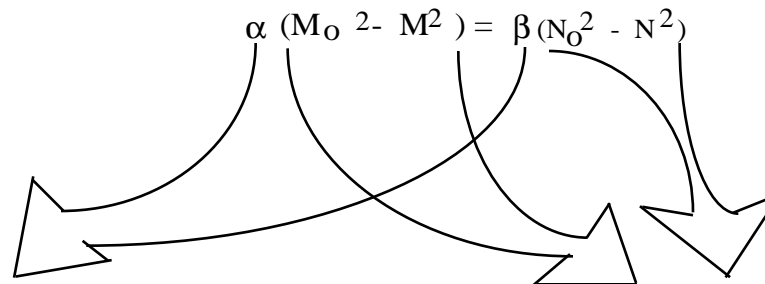
FIRST STEP

- Use NTC/BCTP data:
 - Digital
 - AAR
 - THP
 - Comm tapes
- Construct statistical models:
 - Planner
 - Preparer
 - Executer
- Develop a statistical unit:
 - Stovepipe
 - Correlation
 - Command and control
- Measure opportunities
- Investigate cause and effect
- Model fog



PRIORITIZING RESEARCH

(WITH APOLOGIES TO FREDERICK LANCHESTER)



- EFFECTIVENESS IN DELIVERING LETHALITY

- EFFECTIVENESS IN REDUCING VULNERABILITY

- ARMOR
- INFANTRY
- CAVALRY
- ARTILLERY
- AIR DEFENSE
- ENGINEERS

- PRIME TASKS

- SOME SECONDARY TASKS

- BEHAVIOR

- EFFECTIVENESS IN POSITIONING FORCES

- EFFECTIVENESS IN CONSTITUTING FORCES

- REARM
- REFUEL
- RESUPPLY
- RECOVER
- REPAIR
- MAINTAIN
- TRANSPORT
- PERSONNEL

- PRIME TASKS

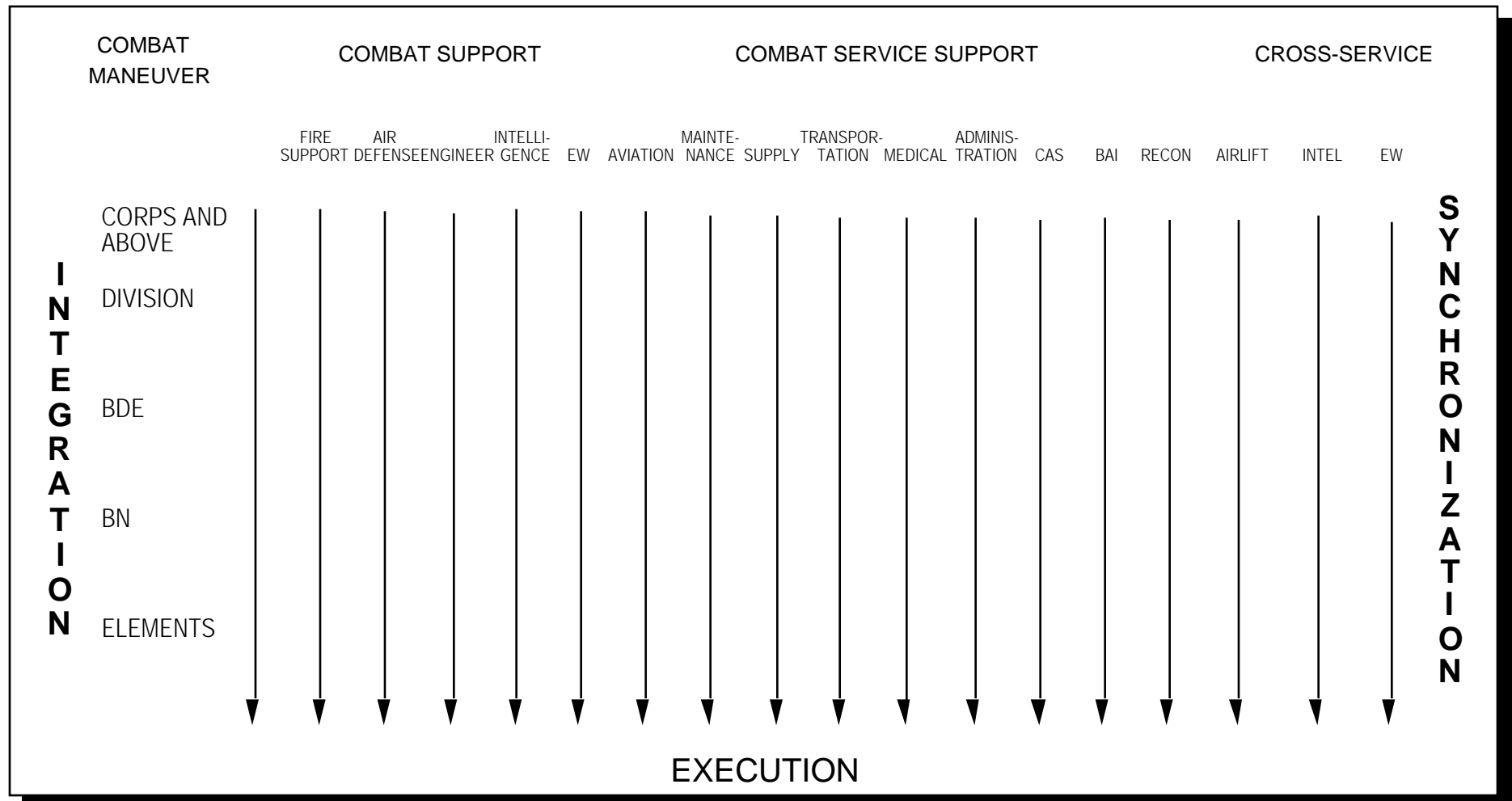
- SECONDARY TASKS

- BEHAVIOR



TACTICAL SYNCHRONIZATION

THE C² MATRIX





In closing:

- While rule based approaches to modeling command and control show promise, statistically based models are worthy of consideration
- The desire to represent human performance and human behavior, particularly in cognitive processes, can be satisfied by statistically based models
- There exists a rich source of data for statistically based models -- the archives of the combat training centers and the battle command training center. Care and effort is needed to collect and process the appropriate data
- Care must be taken with structural variance and its analogue instabilities. We have not seen the last of them



NEEDS

- Baselines
- Deterioration and recovery of prime task performance:
 - Natural environment
 - System environment
 - Soldier/system interface
- Deterioration and recovery of willingness to participate:
 - Motivation
 - Morale
 - Cohesion
 - Well-being
 - Preparedness
 - Experience

— Continued —



NEEDS

(Concluded)

- Deterioration and recovery of leadership/supervision
 - Motivation
 - Morale
 - Cohesion
 - Well-being
 - Preparedness
 - Experience



WHAT SOLDIER ATTRIBUTES?

- Basic abilities:
 - Vigilance
 - Reaction time
 - Perception
 - Cognition
 - Memory
 - Psychomotor
 - Physiological capacity
- Training
- Knowledge
- "Intangibles":
 - Motivation
 - Morale
 - Leadership
 - Cohesion



WHAT DYNAMIC PROCESSES?

- Stress/recovery:
 - Physical
 - Emotional
 - Mental
- Environment:
 - Thermal
 - Mechanical
 - Auditory
 - Visual
 - Toxic
- Combat



WHAT MEASURES?

- Task performance:
 - Time
 - Accuracy
 - Completeness
 -
 -
- Behavior:
 - Probability
 - Duration



STRESS/RECOVERY

- Baseline performance
- Deficit/restoration
- Thresholds -- constant performance
- Rates of deterioration and recovery
- Role of intangible factors

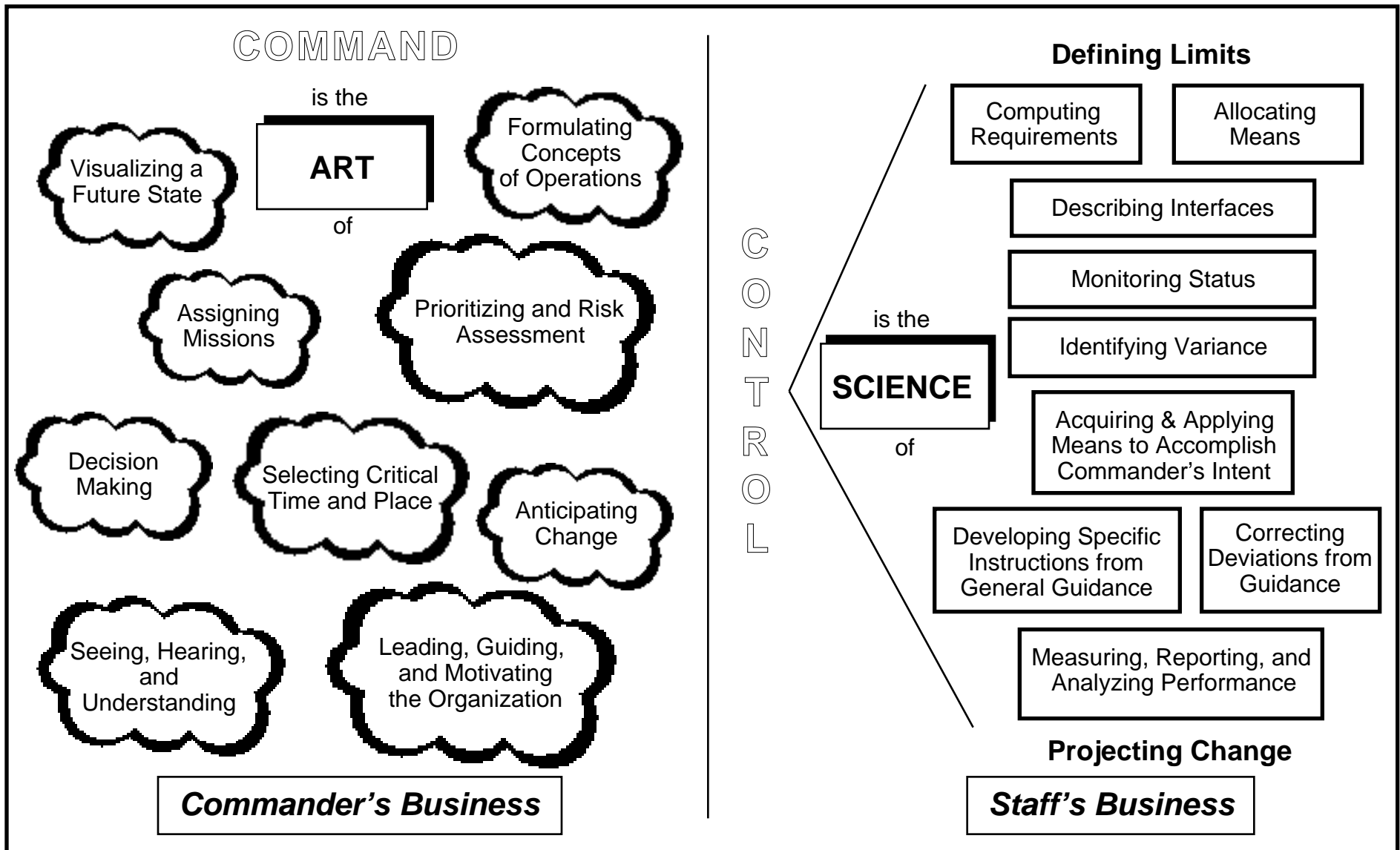


MODELING TECHNIQUES WITH SPECIAL RELATIONS TO COMMAND AND CONTROL

- Make many model runs
- Use an interpretive model in addition to a predictable one
- Deal explicitly with simulated commanders' utility functions
- Emphasize breadth of analysis at least as much as depth
- Consider imperfections in command, control, and implementation



COMMAND AND CONTROL





THOUGHTS ON COMMAND AND CONTROL AND MODELING

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**Presented at
The Representations of Command and Control
Decision Making in Combat Simulations Workshop**

26 February 1996

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